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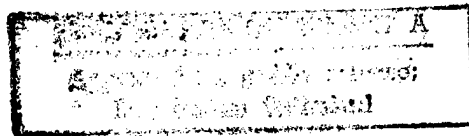
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China Report

SCIENCE AND TECHNOLOGY

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21 October 1982

CHINA REPORT

SCIENCE AND TECHNOLOGY

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APPLIED SCIENCES

SEISMOLOGIST PREDICTS MAJOR EARTHQUAKE

OW101407 Beijing XINHUA in English 1218 GMT 10 Sep 82

[Text] Beijing, 10 Sep (XINHUA)--Ten indicators suggesting an imminent earthquake have been outlined by Mei Shirong, of the Chinese State Seismological Bureau here today. She was addressing the current international symposium on continental seismicity and earthquake prediction.

The 10 indicators are:

1. Usually before a large earthquake, there are numerous minor tremors that occur from several days to several months before the disturbance. The 1975 Haicheng quake was preceded by 600 tremors in 1 year. However, another entirely opposite indicator is abnormal tranquility, as in the case of the 1976 disastrous Tangshan earthquake, when only three small tremors occurred in 3 months preceding the Knoll taking.
2. There is a growing incidence of faulting of the land.
3. The level of underground water sometimes drops and very often rises again 2 weeks before a major quake.
4. The chemical components of underground water change. There are abnormalities in the content of radon, carbon dioxide and fluoride and chloride ions.
5. The natural electric field in the quake area often registers drastic changes a few days before a major quake. Drops or rises in the earth-resistivity in the place often occur a few days to a few weeks before the quake.
6. There is also a drop in earth's magnetic field 1 to 2 months preceding the quake and a speedy rise again a few days before it.
7. No less than several dozens of kinds of animals tend to display signs of abnormality about a day or so before a quake, and such abnormality reaches a climax about 2 to 3 hours beforehand. This is attributed to the noise of the cracking of underground rocks, undetected by human ears but audible to the animals sensitive hearing, the letting out of hydrogen sulphide gas and the elevation of underground temperature--which very often brings hibernating animals out--and to low-frequency vibration of the air.

8. There is abnormal underground sound which increases in frequency and then suddenly stops just before the quake.

9. A few days before an earthquake the records of many quake detecting instruments often fluctuate greatly in a cyclical way.

10. Because of the abnormal electromagnetic wave, there is radio jamming, especially in short wave radio communications.

After listing these 10 indicators, Mei Shirong said earthquake prediction is such a difficult field that although, generally speaking, these 10 are accurate and helpful, many other factors also complicate the matter. So, she told the symposium, they are only indicators of earthquake possibility and cannot be considered determining factors. She called for further study on physical processes of seismic source and said China still has a long way to go in the field.

CSO: 4010/4

APPLIED SCIENCES

EXPERIENCE IN QUAKE PREDICTION

OW121037 Beijing XINHUA in English 0739 GMT 12 Sep 82

[Text] Beijing, 12 Sep (XINHUA)--The experiences of China's several successful earthquake predictions show that, to a certain extent, earthquake is predictable, said Chen Xinlian, secretary-general of the Chinese Society of Seismology today. He is attending the international symposium on continental seismicity and earthquake prediction now in session in Beijing.

In an interview with XINHUA, he said that earthquakes were predicted successfully in China including the 7.3-magnitude Haicheng earthquake in Liaoning Province, on 4 February 1975; the 7.3-magnitude Longling earthquake in Yunnan on 29 May 1976 and the 7.2-magnitude Songpan earthquake in Sichuan on 16 August 1976.

Professor Chen said, thanks to the accurate time and place predicted and timely anti-quake measures taken, very few people were killed in these shocks, though more than 90 percent of the houses collapsed and farmland destroyed in the epicenter areas. In Longling, over 420,000 houses were ruined, but the number of the killed was less than 0.5 per thousand of the total population in the 1,800-square-kilometer quake-stricken area.

The main indicators prior to the Haicheng earthquake included the increased intensity of small earthquake clusters, and the levelling anomaly, the increase in abnormality of underground water level, animal behaviours, and other signs including geoelectric resistivity and the radon content in water and the fore-shocks.

Chen said, in the past 7 years, the Chinese Society of Seismology has organized scientists to reevaluate these indicators and expound them in theory. After much field work in checking, reexamining and analysing, they hold the view that these anomalies regarded as the basis for the prediction of Haicheng earthquake are reliable. With experiment and research on some phenomena, the scientists obtained some helpful conclusions. For example, the coming out of the hibernating snakes is also caused by the overflow of underground gas, not the sole increase of earth temperature.

The seismologists also discovered that prior to Haicheng quake, these anomalies occurred simultaneously over a large area and when these anomalies change they change at the same time.

Although earthquake prediction is still at the probing and research stage, Professor Chen said, by selecting reliable anomalies and studying their occurrence, development and interrelations, earthquake can be predicted to a certain extent by using the comprehensive prediction method.

Through observation and research in the past dozen years, Chinese seismologists have analyzed a number of earthquakes and accumulated experiences. The comprehensive prediction method conforms to China's actual conditions and is of great importance to strong earthquake prediction at the present stage.

Chen Xinlian pointed out that besides the professional observation of seismic activity, crest deformation, underground water, geoelectric resistivity and geomagnetism, another important factor is to popularize seismic knowledge among the people and rally them to set up monitoring points. The people had provided a vast amount of valuable information for the successful earthquake predictions in China, he added.

However, earthquake prediction is a complicated and difficult problem, he said. The international symposium has provided Chinese and foreign seismologists a good opportunity to exchange their experiences and cooperate.

Chinese seismologists, he stated, are willing to contribute their findings for improving earthquake prediction and learn from their foreign counterparts.

CSO: 4010/4

APPLIED SCIENCES

YUNNAN EARTHQUAKE FORECAST CENTER OPERATIONAL

OW101050 Beijing XINHUA in English 0701 GMT 10 Sep 82

[Text] Kunming, 10 Sep (XINHUA)--Though still under construction, an experimental earthquake forecast center in a seismically active area in the western part of Yunnan Province has already begun collecting and processing data through its computer system.

The Dianxi (western Yunnan) Earthquake Forecast Center, which operates under the State Seismological Bureau, is one of the biggest in China, according to a spokesman for the center. Its computer system receives, processes and analyses data from a network of substations now being established in a 40,000 square kilometer area. The region is noted for its complex geological structures and frequent seismic activities, the spokesman said.

The center will mainly engage in research into ways of forecasting earthquakes through seismological observations and simulating tests, the spokesman said. Other subjects of research include deformation of the earth's crust and the theories and techniques of forecasting earthquakes using terrestrial magnetic methods.

The main building of the center and part of the scientific instruments have been put to use, the spokesman said.

The center is open to foreign seismologists, according to the spokesman. The scientists would be happy to cooperate with their foreign colleagues in a variety of fields relating to seismology, right at the center, he added.

China is a seismically active country. The most destructive earthquake in recent years took place on 28 July 1976 in the Tangshan-Fengnan area of Hebei Province, which took 242,000 lives.

CSO: 4010/4

APPLIED SCIENCES

DEVELOPMENTS, ACHIEVEMENTS IN DRILL ENGINEERING REPORTED

Beijing TANKUANG GONGCHENG [PROSPECTING ENGINEERING] in Chinese No 4, 20 Aug 82
pp 2-5

[Article by Geng Ruilun [5105 3843 0243] and Zhou Guorong [0719 0948 2837]:
"China's Recent Developments and Major Achievements in Drilling Engineering"]

[Excerpt] Developments and achievements in drill core exploration since the founding of the People's Republic

After the birth of the New China, the party and the people's government have paid extremely important attention to geological mineral exploration. Drill core exploration is a necessary engineering technique for geological ore search and rapid development has been made. Beside geological ore search which uses a small amount of drill core exploration, exploration technology is also widely used in hydrogeology, engineering geology, and engineering construction. Up to now, departments which are equipped with exploration engineering technology already include geology, metallurgy, coal, second machine-building industry, railway, water conservation, electric power, communications, construction materials, chemical engineering, city construction, agriculture and forestry, and national defense construction. The number of core drills in operation in country totals 5,000 to 6,000 units. The cumulative exploration footage has reached about 300 million meters. Large amounts of mineral resources have been prospected for state socialist construction and gigantic contributions have been made in foundation exploration for many water conservation hydroelectric power, railway, communications, and city and national defense construction projects. Looking back to the more than 30 years since liberation, the course of development of drill core exploration not only can be used to compare the new and the old social systems but also should be used to clearly establish the future direction of development as a continuation of the past and on the foundation of achievements already accomplished.

1. From the beginning of liberation to 1952, the country was in a period of economic recovery. Because of the extremely weak foundation in geological exploration work, the work in this period was primarily in the area of establishment. The people's government took over the original Peiping Department of Geological Investigation, Department of Geological Investigation of the Ministry of Economics in Nanking, the Mineral Survey and Exploration Office of the National Resources Commission, as well as the geological investigation departments

and mining organizations of various regions. It also very quickly organized a number [of] exploration teams to implement exploration work. In September 1950, the Commission [or Committee] for the Direction of Geological Work Planning was established, under which the Bureau of Mineral and Geological Exploration was set up to lead the geological work in the entire country. In 1952, the Ministry of Geology was established, under which the Department of Mineral Exploration Engineering was set up, and geological exploration by geological departments was started on a national basis. At the same time, geological exploration work was also started by the coal departments (then the Ministry of Fuel Industries), metallurgical departments (then the Ministry of Heavy Industries), as well as the departments of hydroelectric power and railways. At the beginning of this period, old exploration equipment left by the Old China was used and drilling methods included the use of hard alloy drill bits, iron sand drill bits, and extremely small quantities of diamond drill bits. Later, based on the conditions in the country, Soviet hand-held drills were imported, using primarily hard alloy and iron sand drill bits. This did not compare with the world's advanced standards. For example, the drilling power used--A22 and H22 diesel engines--very quickly became obsolete and were eliminated. Even then, the use of entire Soviet exploration equipment and technology provided the foundation for the establishment of exploration work in our country. During this period, the state also invited a number of Soviet exploration specialists, and schools and training classes for the training of geological exploration technical personnel were started by the geological and metallurgical and coal systems. Large exploration teams were also used to train local technical exploration teams were also used to train local technical exploration workers (such as the then Tongguanshan, Baiyinchang, Daye, Xuanhua, Baiyun, Obo, and Weibei exploration teams).

2. Starting with the First Five-year Plan, development in geological exploration work gradually took place in accordance with the needs for national economic development. The amount of exploration work increased gradually from year to year. By the middle of the Second Five-year Plan of 1960, more than 5,000 core drills were in operation and annual exploration footage was in excess of 10 million meters. During this period, exploration technology involved primarily Soviet equipment and experience. However, the spirit of self-reliance began to be developed. The various areas of production and technical management gradually became normalized, and technical innovation by the masses and new records emerged repeatedly. The Beijing Geological Institute, Beijing Mining Institute, Zhongnan Mining and Metallurgical Institute, as well as local higher and specialized institutions in Changchun and Wuhan began to provide to the society specialized talents in exploration engineering. The Exploration Technology Research Institute was also established in 1957 to specialize in the scientific research of exploration technology. The rate of exploration per drill-month increased to over 270 meters in 1960. In the area of drill core exploration, accomplishment of "Rules of Operation for Exploration"; summary of operating experience in hard alloy drilling and iron sand drilling; advanced exploration records achieved by the Zhongnan 404 team and the Ximeng team of Neimeng [Inner Mongolia]; wide attention to slurry hole protection; initial adoption of coreless drilling in accordance with local conditions and creation of a set of scrapper drill bits; successful innovation of a number of mechanized tools for raising and lowering operations, such as the column type pipe moving and placing

installation, Guanmenshan type lifter, Tangshan type and Liaoning type pipe twisters, etc; initial adoption of hydraulic pressure vertical axle type drills (3 ϕ -300, 3 ϕ -650, 3 ϕ -1200) and the conversion of the original KAM model hand-held drill to advancement with hand wheels and rod inversion without stopping drill; etc. These accomplishments and experiences had an important effect at the time in maintaining the continuous improvement of efficiency of exploration production and in reducing the labor intensity of the workers. The practical significance of the same experiences remains even today. Those in scientific research worth mentioning are; start of air cleaning of wells, analysis of drilling mud-making (bentonite), instrument for inclination survey, core recovery in complicated rock formations and the study of classification of rock drillability and hole bottom electric drilling.

3. From after the second year of the Second Five-year Plan to 1976, the country was in its 3 years of economic adjustment and the turmoil of the 10 years of "Cultural Revolution." During this period, the national economic development was greatly affected. However, with efforts exerted by the large geological ore search staff and workers and their self-reliance and hard struggle, some progress was still achieved in exploration work. This is concretely reflected in the following areas:

(1) Domestic design and manufacture of exploration equipment and instruments

The drills designed and manufactured included 100-meter, 300-meter, 600-meter, and 1,000-meter depth capability hydraulic pressure vertical axle type drills of the geological system [refers to organizations under the geological system], model Beijing-500 rotary table type drill of the metallurgical system, models TXU-700 and 1,000 drills of the coal system, as well as SPC-300, SPJ-300, and Red Star 300 drills used for hydrology and water wells, model SH-30 drill used for the exploration of engineering foundation, and large diameter concealed-hole vibrating rotary drill, etc. At the same time, drill towers and mud pumps used with the above drills were also designed and manufactured. Inclometers that could be used in both non-magnetic and magnetic mineral areas were also designed and manufactured. As a result of this work, the past situation of primarily relying on imported exploration equipment has come to an end.

(2) Taking hold of the manufacturing technology of diamond drill bits

At the beginning of the 1960's, the Exploration Technology Research Institute of the Ministry of Geology and the Zhuzhou Hard Alloy Plant cooperated in the study and manufacture of diamond drill bits. By 1963, surface impregnated natural diamond drill bits were successfully manufactured using cold pressure soaking and sintering method. This was the beginning of diamond drill bit manufacturing and the use of diamond bits for drilling in our country. Around 1970, the Ministry of Metallurgy and the Institute of Physics of the Chinese Academy of Sciences first called for and started the experimental research of artificial diamond drilling. This had an important effect in pushing forward the development of diamond drilling in our country. In 1974, a technical exchange conference on artificial diamond drilling was held at Xikuangshan in Hunan. At the same time, appraisals were made of artificial diamond drill bits originally used in the drilling of tunnels and developed and manufactured by

the Geological Research Institute of the Ministry of Metallurgy, Beijing Powder Metallurgy Research Institute, Lanzhou Petroleum Equipment Research Institute, Exploration Technology Research Institute of the Ministry of Geology, and the Shanghai Grinding Wheel Plant. Thereafter, continued improvements were achieved in the manufacturing technology of diamond drill bits and reamers, and the use of artificial diamond bits was applied to drill core exploration on the ground surface.

(3) High strength pipe materials for geological work researched and manufactured

Up to the end of the 1960's, the steel pipes used for geological exploration had always been imitations of the Soviet Union and adopted the use of large quantities of drill rods, casings, and core pipes made with No "II" steel (equivalent to No 45 steel). The tensile strength was 65 kilograms per square millimeter and the yield strength was 38 kilograms per square millimeter. Friction losses were rapid and accidents due to breakage were numerous drilling. And the requirements for diamond drilling were not met. Under the direction of the Bureau of Standards of the Ministry of Metallurgy and jointly with the users, the steel pipe standards "YB235-63" and "YB235-70" meeting the requirements of hard alloy--steel pellet drilling for geological exploration and the steel pipe standard "YB848-75" meeting the requirements of small diameter diamond drilling were established. Beside improvements in sizes, the use of No "II" steel, employed originally, was abandoned in the latter two standards, and the use of manganese, molybdenum, vanadium, titanium, and boron-bearing low alloy steel elements of which our country has rich resources, was adopted. The lower limit of yield strength was established at 50 kilograms per square millimeter. The requirement for drill rods and core pipes was set at 65 kilograms per square millimeter.

(4) Improvements in drilling techniques

In order to guarantee the engineering quality of exploration, the broad masses of technical exploration personnel and workers have created many types of core recovery tools of special characteristics. These core recovery tools have totalled as many as 50 types in 6 categories, namely single pipe core recovery drill, double action double pipe drill, single action double pipe drill, anti-circulation drill, core recovery drill for diamond drilling, and mineral core recovery support tool. As a result, the core recovery quality in exploration has been guaranteed to a very major degree for many of the minerals for which core recovery is difficult, including phosphorous, sulfur, graphite, mica, mercury, asbestos, talc, loose and soft coal formations, and various types of hard, brittle, and broken mineral formations.

Diamond drilling requires high rotational velocity. To meet this requirement, the metallurgical and geological systems and related institutes and universities and plants have successfully experimented with the production of saponified oil, Archaean oil, (sulphonated neat's foot oil), No 126 emulsion lubricant, and lubricating grease, etc. Under general conditions, the drill rotational velocities are able to satisfy the advancing rate of diamond impregnated drill bits in 600- to 800-meter and even 1,000-meter deep holes. This accomplishment has created the conditions and opened up the situation for the use of diamond impregnated drill bits for exploration drilling on the ground surface.

Another improvement of technique is the use of light, nondispersion, low temperature solid phase drilling mud. High quality (bentonite) powder is used for drilling mud and polymerized propylene acyl amine high molecular polymer has been studied for the preparation of drilling mud. The Exploration Technology Research Institute and the Red Flag Chemical Plant of Mudanjiang were successful in the research of iron chromium lignin sulphonate, which has filled a blank in our country's mud treatment agent.

(5) Adoption of many types of drilling methods

At the beginning, coreless drilling was practised depending on local conditions. Because of the successful adoption of coreless drilling by the coal departments, vast improvements in the efficiency of coreless exploration drilling were achieved and the drill-month rate always topped others in the country. The Exploration Company for the Liaoning coal field established the annual record for a single drill of 20,000 meters.

In impact rotary drilling, the Exploration Technology Research Institute had at one time started research and production experiments before 1966. Later, systems under the Second Ministry of Machine-Building Industry along with the Bureau of Geology of Liaoning Province and the Geological Institute of Changchun conducted numerous experiments. Beside the use of valve type impacters, jet type impacters were created. This established a foundation for the use of the impact rotary technique in our country.

Directional drilling has been adopted in a number of mining regions in Yunnan, Sichuan, Guangdong, Heilongjiang, Shaanxi, and Hunan. One type is the use of natural curves to drill directional holes. The other is the use of incline guides and artificial curves to drill directional holes. Although directional drilling techniques and equipment are not yet perfected, actual experience has proved the economic benefits of directional drilling in some of the mining regions. For example, engineering quality of exploration and smooth progress of exploration work have been guaranteed, the volume of exploration work conserved, rejected work projects avoided or reduced, and exploration period reduced.

Cable core-recovery drilling has begun to be experimented with by the geological, metallurgical, and coal systems. Technical appraisal is being carried out on the S-56 drill.

In addition, research and experimentation have been conducted on the hole bottom electric drill and the turbine drill. On behalf of the coal departments, the Exploration Technology Research Institute has used the $\phi 168$ electric drill and has experimented successfully with drilling of frozen holes requiring a high degree of perpendicularity. The Second Machine-Building system has carried out production type experiments with its small diameter turbine drill.

4. In the more than 5 years since 1977, in order to satisfy the needs of four modernizations for geological mineral production, the party and the state have shown great concern for the development and improvement of geological exploration work. The various related geological exploration departments have placed

their efforts toward improving the engineering quality and production efficiency of exploration, improving the coordination between exploration equipment and its supporting instrumentation as well as their technical properties, and at the same time improving the labor protective conditions of the onsite operating personnel. The diamond drilling experience exchange conference conducted in Guilin in the spring of 1977 by the three ministries and one bureau (Ministry of Coal Industry, Ministry of Metallurgy, Second Ministry of Machine-Building Industry, and the Bureau of Geology of the State Planning Commission) and the Second National Exploration Engineering Academic Conference conducted in Beidaihe in November 1979 not only engaged in the exchange of experiences in the accomplishments achieved in past exploration work, but at the same time also explored existing gaps in exploration work. Through specialized inspections and technical meetings abroad in recent years, the direction has been further clarified on how to absorb advanced foreign experiences and carry out the modernization of our country's exploration engineering based on our own conditions. In the area of drill core exploration, the exploration sector commonly believes that the primary emphasis should be in gradually expanding hard alloy and diamond drilling while, at the same time, important attention should be given to the many types of methods and techniques of impact rotary drilling, coreless drilling, core drilling without lifting the drill, directional drilling, and drilling with air cleaning of wells. Even greater attention should be paid to the application and research of new types of mud in drilling and in wall protection and the stopping of leaks. Drilling and core recovery techniques in certain complicated rock and mineral beds should be mastered. A firm hold should be made on deep hole drilling techniques of 2,000 to 3,000 meters which are needed for the reasearch of geology at depth. For the development of hydrogeology and engineering geology, skills and technology for hydrological and water well exploration and for engineering geology exploration should be vigorously improved (especially for large diameter drill holes). In exploration equipment, instruments, and tools, efforts must be made to gradually achieve standardization, systematization, and interchangeability. In the systematization of drill tools, rational standards should be studied and established while paying attention to coordination with common international standards at the same time. And, in order to reach these goals, very serious attention must be given to the education and training of technical personnel and to scientific research work, and mass technical innovation movements should be launched and developed.

Through their efforts in the last 5 years, the various related research institutes and universities and geological exploration departments have achieved gratifying results in the above described areas. As a result, notable improvements have been made in our country's exploration technology and production level. These improvements together with earlier achievements after the founding of the People's Republic have given us a new look. Our current levels in this field are:

- (1) Diamond drilling has been widely promoted. The ratio of diamond drilling in the various departments is now between 10 to 30 percent. In 1981, more than 600 diamond drills were in operation in the country. The drill-month rate of diamond drilling now averages 350 to 500 meters for the entire country, with manu units achieving rates of over 600 meters. Some departments plan to basically eliminate steel pellet drilling by 1985.

(2) Manufacturing techniques of various types of diamond drill bits are already under control. These include the cold pressure method, soaking method, hot pressure method, and electroplating method, etc. The properties and quality of drill bits have been continuously improved and varieties of drill bits have been continuously improved and varieties of drill bits gradually increased. The average life of diamond drill bits in the country is now 35 to 40 meters of drilling. In limestone and gneiss, the average life in many instances exceeds 100 meters. Diamond drill bits have begun to be exported.

(3) Single crystal quality and quantity of artificial diamonds produced already are able to satisfy the needs of diamond drilling in the country. Various types of polycrystals, surface impregnated drill bits have shown very good results when used in medium and hard rock formations. Research in the manufacture of composite [flakes] is actively moving forward.

(4) Cable core recovery drilling is being expanded. Currently, about 70 cable core recovery drills are in operation. Total footage drilled with these drills is over 100,000 meters with very good technical and economic results. The diameters of existing drills are 46, 56, 60 and 76 [no unit given!]. Compared to common core recovery methods, drilling time and drill-month efficiency can both be improved by about 25 to 30 percent, drill bit life is increased by 25 to 50 percent, and both rock and mineral core recovery rates are above 90 percent. Using cable core recovery, record depths of holes of 2,370 meters, 1,896 meters, and 1,500 meters have been established by the geological, coal, and metallurgical systems respectively. Some difficult problems of evaluating geological minerals at depth have been solved.

(5) Hydraulic impact rotary drilling is gradually being development and improved. The departments of the Ministry of Second Machine-Building Industry, Ministry of Geology, and Ministry of Metallurgy have used various types of hydraulic impacters in recent years (including Models JSC-75, YE-2, YC-75, and 726 and various types of jet and valve impacters). Over 100,000 meters have been drilled. Relatively good results have been achieved in Classes 7 and 8 and some Class 9 rock formations. The deepest hole exceeded 600 meters. High frequency diamond impact rotary drilling is in the experimental stage. There is hope that results can be achieved in hard, (smooth) formations.

(6) Development in engineering geology exploration has been very rapid. It is widely used in railway, communications, bridge foundations, water conservation and hydroelectric dams, harbors, air fields, subways, and warehouses and tall urban building foundations, and foundation pilings. Currently, about 2,000 engineering drills are in operation in the country. In past years, they were used in such large scale foundation exploration tasks as the foundations for the Yangtze Bridge in Wuhan, Yangtze Bridge in Chongqing (using 3-meter diameter gear wheel drill), and the hydroelectric projects of Gezhouba of Yangtze River, Longyangxia of Huang He, Liujiaxia, and Gongju of Dadu He. Some of the drill hole recovered cores were 1 meter in diameter.

(7) Technology for hydrological and water well exploration and geothermal exploration (including thermowater wells) has been continuously improved. Nearly 1,000 hydrological and water well drills are in operation in the country. The

figure is more impressive when the number of units for well drilling in local urban and rural areas is added. The current development is towards deeper and larger diameter wells. For example, deep water wells of over 500 millimeters in diameter and 500 meters in depth have already been drilled in Xian. The wells completed in the Beijing-Tienjin area have depths of 800 to 1,200 meters and some even over 2,000 meters. In the high-temperature steam geothermal drilling of the Yangba well in Xizang, the technical problems involved were great and numerous. With the help of engineering technical personnel from the Exploration Technology Research Institute, the earth formation pressure gradient of the thermal field was finally understood, gushing from the well was placed under control, and meaningful results were achieved.

(8) Superior drilling mud has been vigorously promoted. In addition to emphasizing the selection of superior [bentonite] for making drilling mud and the use of low solid phase mud, the use of high molecular polymer mud of propylene acyl amine and other compounds is being widely promoted. Potassium treated mud, frothed mud, and salt solution mud are also adopted on the basis of the special properties of the earth formations. At the same time, cement is being rationally used to geologically seal leaks and casings and to protect drill holes, and many complicated formations have been surmounted.

(9) Directional drilling is being positively adopted. Because of difficulties of preventing the slanting of drill holes caused by geological factors, the geological goal can only be achieved by directional drilling. The departments of metallurgy and geology have already started the development of moving gradually from an initial level of determining directional holes [utilizing the law of slanting of holes (TN: probably referring to making compensations)] to artificial control of directional drilling. Initial results have been achieved in experiments using bottom rock cores to determine directions.

(10) Assembly of exploration equipment, instrument, and drill tool components are being perfected. A series of core drills for exploration to depth of 100, 300, 600, 1,000, and 1,500 meters are available. Also available are 100-meter tunnel drill as well as new models of 600-meter and 1,000-meter hydraulically driven powered bit drills. Also available are broken down and car mounted engineering drills for drilling depths of 30, 50 and 100 meters, large diameter hydrological and water well drills for drilling depths of 200, 300 and 500 meters, and 0.3- to 1.5-meter diameter hole engineering construction drills. Also available are mud pumps, moving equipment, and drill towers for above types of drills, a set of exploration parameter instrumentation and mud testing instruments, and several types of inclinometers. Pipe standards are already available to be used, but preparations are being made for their revision. Standards will soon be established for various types of core recovery tools.

(11) Academic movements are very active. Since its establishment on 2 April 1964, the Special Exploration Engineering Committee of the Geological Society has staged two national academic conferences for exploration engineering, one in 1965 and the other in 1979. To meet the needs of exploration engineering development, the society conducted in 1981 a thesis report and discussion conference on four special subjects (cable core recovery, impact rotary drilling, tunnel exploration technology, and exploration instrumentation). This conference had a positive effect for the exchange of experiences and for pushing forward the development of exploration engineering technology. Currently, more than 20 provincial, municipal, and autonomous region geological societies

have established special exploration engineering committees, and local academic movements have been actively organized.

Reviewing the development and major accomplishments of exploration engineering in our country since the beginning of the century, we can see clearly that the exploration capabilities during the more than 40 years before the establishment of New China were very weak. Total exploration during that period is estimated at approximately 700,000 meters. During the more than 32 years after the establishment of New China, exploration work has totalled roughly 300 million meters. Nearly 20 departments of the state now have exploration engineering technology capabilities. About 6,000 drills are in operation in the country. Under the leadership of the Chinese Communist Party, the large exploration staff and workers have moved to work in different parts of the fatherland over the years. They have found large quantities of energy resources, minerals, construction materials, chemical raw materials, and underground water resources for the construction of socialism for the state, and have conducted basic investigations and engineering constructions for many water conservation, hydro-electric, road, bridge, harbor, and large building projects. During this celebration of the 60th anniversary of the Chinese Geological Society. The large workers, cadres, and technical personnel of the country's exploration engineering sector are even more full of confidence and, on the basis of the results already achieved, should locate where the gaps are and really work hard in order to produce new results for the continuous improvements of exploration engineering technology and techniques and production level, and for the four modernizations of the fatherland.

5974

CSO: 4008/223

APPLIED SCIENCES

BRIEFS

CHINESE CHARACTER MICROCOMPUTER--Beijing, 24 Sep (XINHUA)--China has developed a microcomputer for processing Chinese characters, according to the Ministry of Electronics Industry. Designed on a modular structure, the newly developed microcomputer, ZD-2000, consists of a controller, a visual display, a floppy disc for storage, a Chinese character keyboard and an English keyboard. The computer can be utilized in drafting compositions and documents, enterprise management and processing information. The functions of the computer include insertion, deletion and correction of character and typesetting. The ZD-2000 computer can also be connected with other computers to form a large, Chinese character information processing system. [Text] [Beijing XINHUA in English 0749 GMT 24 Sep 82]

CSO: 4010/1

LIFE SCIENCES

REPORTER TALKS WITH CUI YUELI, MINISTER OF PUBLIC HEALTH

Beijing JIANKANG BAO in Chinese 29 Aug 82 p 1

[Report on interview with Cui Yueli, minister of public health, by JIANKANG BAO reported, on the eve of the opening of the 12th Party Congress; place not specified]

[Text] On the eve of the opening of the party's 12th congress, Cui Yueli, minister of public health, spoke to a reporter of this newspaper saying that since the Third Plenary Session of the 11th Party Congress, the various ranks in the public health departments have paid attention to overcoming the influence of leftism in their work carrying out the policies of the party, implementing the readjustment objectives, and emphasizing the function of young intellectuals. Some new progress has, therefore, been made in such aspects as prevention and control, medical treatment, Chinese traditional medicine, scientific research, education, and planned parenthood. Through the movement of "5-lectures and 4-beautifications" the attitude of service has been further improved to raise the quality of disease prevention and control as well as the level of health of the people.

Comrade Cui Yueli said: "Due to the fact that prevention and control have continued to be the goal for several years, a patriotic hygiene movement has strengthened the work of public health and epidemic prevention so that the incidence of some diseases has been further reduced. Comparing 1981 with 1978, the incidence of diphtheria, epidemic encephalomeningitis, pertussis, scarlet fever, and 12 other acute infectious diseases has been decreasing in various degrees. Now, about 95 percent of the inhabitants of regions of endemic thyroidian are taking iodized salt, and a large number of patients have been cured of it. In the prevention and control of schistosomiasis, such comprehensive measures as snail extermination and sewage management, etc., have been adopted. New achievements have been obtained in that field also; 1.04 million victims of that parasitism have been cured.

With regard to medical treatment in rural villages, Cui Yueli said that with the extension and perfection of the system of responsibility of agricultural production, the medical and public health organizations of production brigades have taken on many forms to suit the locality so as to mobilize the positiveness of all sectors. As a result, the 610,000 brigade public health centers and the 1.3 million barefoot doctor teams are stabilized and developed so that

the rural villages all over the country are basically provided with medicine and drugs and have persons to do the work of prevention, control, and planned parenthood.

In order to carry public health work to the rural villages, public health organizations of the county level and below in the entire country have been built up as key points beginning in 1979. In these 3 years, the public health organizations of 300 counties have been reorganized. After the consolidation, the number of leaders and professional staff has been raised from 50 to 70 percent and technical training has started for 40-50 percent of the employees. Consequently, the level of medicine, the level of management, and the quality of service of these key counties have all been greatly improved.

Cui Yueli pointed out that while strengthening the Chinese traditional medical organizations and building up the Chinese traditional medical teams, the emphasis has been placed on maintaining and developing the special characteristic of Chinese traditional medicine so that the work of inheriting, exploring, and improving Chinese traditional medicine and pharmacology may succeed. Now, nationally 781 Chinese traditional hospitals have been established, an increase of 74 percent over those of 1978; Chinese traditional medical teams have been developed to include 289,000 persons, an increase of 15 percent over those of 1978.

Cui Yueli said: "With respect to scientific research, 1,459 items resulting from research have been reported in the various provinces, cities, and autonomous regions in the past few years and 175 of these have been approved at the ministerial level." Some of these research accomplishments have relatively great scientific and economic values. For example, afetal protein general survey has become an effective technique now for detecting early stage liver cancer when there are still no symptoms or physical signs. This technique was first discovered in China. The new antimalarial drug, Qinggaosu [essence of *Artemisia apiacea*, Hce.] isolated from the Chinese traditional medical herb has the merits of being fast, effective, and less toxic compared with the drugs currently being used to treat malaria. The semi-synthesized Isoharringtonine [from *Cephalotaxus fortunei* Hook, t; or *C. harringtonia* var.], first successfully produced in China, is a new drug for treating acute nonlymphatic leukemia and places China in a pioneering position in the world. Treatment of infected open fracture of the bone with integrated Chinese and Western medicine has enabled many would-be amputation patients to preserve their limbs and to avoid the pain of being disabled.

Since the third Plenary Session of the congress, the development of China's medical education has also been relatively fast. At present, the country has 112 medical schools of higher education, having added 14 since 1978. These schools have 170,000 students. There are 556 middle level schools of public health, an increase of 36 over those of 1978. In these 3 years, efforts have also been exerted in the field of continuous education for the employees and a total of 800,000 persons have received such training, amounting to 23 percent of the existing public health personnel.

Cui Yueli pointed out that planned parenthood is China's basic national policy. Public health departments have always regarded the technical work of developing birth control to be an important task. At present, more than 20 million abortions are performed every year, and many advanced units and individuals having performed 1,000 to 2,000 abortions without an accident have emerged. They have contributed to the effective control of population increase. Cui Yueli said that the public health departments of all grades are making the construction of the socialist spiritual civilization their own essential work. Through the activities of "5-lectures and 4-beautifications" the public health work has been forcefully propelled forward and many local public health units have taken on a fresh new appearance. All the hospitals have developed the education of medical ethics, formulated rules of behavior, and established a system of job responsibility. There is also a movement of "If I were a patient" to discuss and to choose superior nurses. Very good results have been obtained.

Finally Cui Yueli also said that although some accomplishments have been obtained in public health work in these few years, there is still some distance to meeting the needs of four modernizations construction. Under the encouragement of the spirit of the 12th party congress, all are to double their efforts to work hard for the prosperity of the fatherland, the still faster development of public health affairs, and offering new and greater contributions to improve the health of the masses.

6248

CSO: 4008/227

Geothermics

AUTHOR: LYU Canren [0712 3503 0088]

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TITLE: "Power Analysis of Hot Water Type Geothermal Electrical Power Station and Power Economics of Residual Heat Utilization"

SOURCE: Beijing QUANGUO DIRE XUESHU HUIYI LUNWEN XUANJI [SYMPOSIUM ON GEOTHERMICS OF CHINA, SELECTED WORKS] in Chinese Oct 81 pp 146-158

ABSTRACT: The temperature of the hot water type geothermal resources is below 300°C and on the basis of development difficulties and power utilization, it is further divided into the 3 classes of the high temperature of $>150^{\circ}\text{C}$, medium temperature of $90-150^{\circ}\text{C}$, and low temperature of $50-90^{\circ}\text{C}$. In China, due to the level of prospecting and mining, the group of established experimental geothermal power stations all belong to the medium-low temperature type. Their power rating is not high. There is a need for evaluating the economics, the function, and the meaning of developing this type of station as well as for analyses and investigation of the proper techniques and policies concerning their development. This paper is an attempt of using the law of thermodynamics to analyze the quality and quantity of heat, to discuss the power economic indices of geothermal power stations, and to determine the effect of major temperature variation on usable energy. Through concrete computation, analysis, and comparison of the data of a low boiling point experimental geothermal power station in China, some viewpoints on the importance of comprehensive utilization of low-medium geothermal power stations are proposed.

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TITLE: "Determination of Optimal Parameters of Geothermal Power Generation of the Multi-stage Flash Steam System"

SOURCE: Beijing QUANGUO DIRE XUESHU HUIYI LUNWEN XUANJI [SYMPOSIUM ON GEOTHERMICS OF CHINA, SELECTED WORKS] in Chinese Oct 81 pp 159-168

ABSTRACT: Most of the geothermal resources that have been developed in China belong to the hot water type. From the power generation angle, this is a low grade energy source. If this type of geothermal energy is to be economically and effectively utilized to generate electricity, a reasonable thermodynamic system must be selected according to the actual condition of the resource for designing the needed equipment correctly. The multi-stage flash steam system is one way to achieve reasonable utilization but the first task is to determine the optimal parameters to cause the equipment to possess the highest electricity generating power. The evaporation temperature (or pressure) and the condensation pressure (or temperature) are the most influential parameters because they affect the output, the plant use of power, and the equipment size of the power station. There are existing theoretical equations for computing these parameters but they produce only the most ideal parameters and cannot be used to calculate the actual optimal parameters under the condition of pipe resistance and power use at the plant. If the comparative method is used, a great

[continuation of QUANGUO DIRE XUESHU HUIYI LUNWEN XUANJI Oct 81 pp 159-168]

deal of work is required. For the purpose of simplifying engineering computation, the paper adopts a new multi-stage flash steam parallel equivalent system, using the stage by stage cumulative technique to determine the optimal evaporation temperature and condensation pressure under the condition of having pipe resistance and plant use of power. General purpose line diagrams of single stage and multi-stage flash steam are provided.

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TITLE: "Equipment Design of Expansion Geothermal Power Station"

SOURCE: Beijing QUANGUO DIRE XUESHU HUIYI LUNWEN XUANJI [SYMPOSIUM ON GEOTHERMICS OF CHINA, SELECTED WORKS] in Chinese Oct 81 pp 169-175

ABSTRACT: Using the Huitang Geothermal Experimental Station of Hunan Province as the example, this paper introduces the equipment design characteristic and the operation condition of expansion method power generation using medium-low hot water. The mechanism and prospect of geothermal hot water expansion power generation are discussed. The designing and experimentation of the key equipment - the expansion chamber are analyzed and discussed. The Huitang Station is currently in the transitional period of advancing from an experimental station to a power production station as its equipment is being perfected. After power generation, the leftover water may be used to irrigate 800 mu of fields. The hot water after expansion is supplied to the Academy of Agricultural Sciences for rice breeding, medical therapy, fish culture, and meat processing, as well as to the public bathhouse. In these 5 years, the communes and the local masses have welcomed the project.

6248

CSO: 4009/337

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TITLE: "The Generation and Evolution of Petroleum of the Saline Qianjiang Formation in Jianghan Basin"

SOURCE: Jiangling SHIYOU YU TIANRANQI DIZHI [OIL AND GAS GEOLOGY] in Chinese Vol 3 No 1, Mar 82 pp 1-15

TEXT OF ENGLISH ABSTRACT: Tertiary Qianjiang formation is rich in gypsum and salt. The content of chlorine ions in argillites is 0.1 - 1.5 percent, the average content of organic carbon and hydrocarbon is 0.61 percent, 996 ppm respectively. The kerogen in the Qianjiang formation is of a mixed type with a higher genetic potential for petroleum.

The normal-paraffins of source rocks from the Qianjiang formation mostly fall in the C_{22} - C_{34} range, and show a distinct even-odd predominance with OEP values from <1 to 1 approximately. During the deposition of this formation, in part of the fringing areas where the sedimentary layers have relatively normal water salinity, the normal-paraffins also show an odd-even predominance with OEP values from >1 to

[Continuation of SHIYOU YU TIANRANQI DIZHI Vol 3 No 1, Mar 82 pp 1-15]

1 approximately. These two predominances correspond to each other, but the former is the major one. Therefore, the authors consider the even-odd predominance to be the main path of the hydrocarbon evolution in source rocks of salt lake facies.

Among the isoprenoid alkanes in source rocks of the Qianjiang formation, phytanes are predominant with pristane-phytane ratios (pr/ph) < 1.

Because of the well-developed gypsum and salt and the lower geothermal gradient (2.3 - 3.0°C/100 m) in the Jianghan basin, the evolution rate is slower and the buried depth is deeper than that of the organic matter in common continental source rocks. In the Qianjiang formation, the petroleum generation peak is 3700 m and the lower limit of liquid petroleum generation is 4600 m. Therefore the thickness of the liquid window of hydrocarbon can be up to 2600 m.

The crude oil in the Qianjiang formation can be classified into low-matured oil and matured oil. Its maturity is basically coincident with the maturity of source rocks, which reflects its features of proximity to oil source, short-distance migration and which shows that oil is generated from and reservoired in the Qianjiang formation itself.

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TITLE: "A Study on Organic Matter and the Evaluation of Petroleum Generation Potential of Upper Triassic Maantang Formation and Xiaotangzi Formation in Northwestern Sichuan"

SOURCE: Jiangling SHIYOU YU TIANRANQI DIZHI [OIL AND GAS GEOLOGY] in Chinese Vol 3 No 1, Mar 82 pp 67-74

TEXT OF ENGLISH ABSTRACT: The Maantang formation is made of marine limestone, artillite and siltstone, while the Xiaotangzi formation is mainly composed of delta-front deposit of the transition zone from sea to land and is rich in marine and terrigenous plant fossils. In the past, they were considered major source beds in northwestern Sichuan. On the basis of analyses by various modern apparatus, the author studied the geochemical features of kerogen in these two formations. We concluded that both of the formations have been hydrocarbon-generating, but neither of them is a good source rock. If comparing the two, the Maantang formation is better than the Xiaotangzi formation.

AUTHOR: ZHAO Bai [6392 4101]

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TITLE: "The Prospects of Petroleum Exploration of Permo-Carboniferous in Junggar Basin"

SOURCE: Jiangling SHIYOU YU TIANRANQI DIZHI [OIL AND GAS GEOLOGY] in Chinese Vol 3 No 1, Mar 82 pp 75-80

TEXT OF ENGLISH ABSTRACT: Junggar is a huge faulted basin and is covered by sedimentary rocks, constituting about 130,000 km². The Middle and Upper Carboniferous, the Permian, and the complete Meso-Cenozoic sediments are developed on the Variscian folded basement. The Middle and Upper Carboniferous are marine, transitional and continental deposits. The Permian belong to continental deposits. Both of them are multi-depocenter clastic rocks with abundant organic matter. According to the main geochemical indexes of petroleum generation, they should be the main source rocks in this basin. During the Meso-Cenozoic, the southern part of the basin developed into a deep depression, while the northern part gradually became a southtilting slope. So it is most favorable for the Permo-Carboniferous hydrocarbons to migrate and accumulate toward the northern marginal zone in which the prospecting for oil would be more effective.

AUTHOR: ZHANG Yonghong [1728 3057 7703]

ORG: Jiangsu Brigade of Petroleum Geology

TITLE: "A Preliminary Study of the Prospects of Coal-formed Gas in Carboniferous-Permian System in Xu-Huai Region"

SOURCE: Jiangling SHIYOU YU TIANRANQI DIZHI [OIL AND GAS GEOLOGY] in Chinese
Vol 3 No 1, Mar 82 pp 57-66

TEXT OF ENGLISH ABSTRACT: The Xuzhou-Huaibei-Huainan region is one of the major coal industry bases in China. Around it are Mesozoic-Cenozoic overlapping basins of Zhoukou, Huangkou, Hefei, etc., which are the major prospective areas for exploring the natural gas formed by the metamorphism of coal-bearing formations.

The Carboniferous-Permian coal seams within this region are about 5-30 m in thickness, with sufficient gas source. In the step-faulted zone in the eastern Zhoukou basin and the deep-seated areas in both the east and west ends of the Huainan synclinalorium, the source rocks of gas are well developed. During its deep-buried process the regenerated gas was also formed. Additionally there exist anticline structures and other types of traps, so this region is the main accumulation area of coal-formed gas, and a major prospective area for exploration. Deep-segments in the central basin are places to search for overpressured gas.

9717

CSO: 4009/327

AUTHOR: GAO Jianian [7559 0857 1628]

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TITLE: "Current Situation and Outlook in the Study of Wheel and Rail Steels"

SOURCE: Beijing GANGTIE [IRON AND STEEL] in Chinese No 8, Aug 82 pp 66-70, 54

ABSTRACT: The condition of research in wheel steel is discussed in terms of the stress systems of interactions between the wheel and the steel rail, between the wheel and the brake shoe and the problems of deformation such as abrasion, peeling, and heat injuries. The basic condition of development of steel rails in China is divided into the 3 stages of the production of common carbon steel rails, concentrating on the problems of wear and compression resistance, and continuous study on the problems of wear resistance and starting to resolve the problem of fatigue fracture. At present, the outstanding problems are: (1) Wear and contact fatigue; (2) Scraping injury; (3) Fracture of screw holes; (4) Wave abrasion. It may be said; therefore, that the direction of research, beyond the requirement of wear-resistance, should also include such properties as resisting fatigue, cracking, heat injury, and scraping injury. While developing seamless rails, good welding property remains desirable. The paper also includes a brief review of foreign studies on steel materials and a general description of the progress and problems of the development of rail steel in China.

AUTHOR: None

ORG: None

TITLE: "Conference on Energy Conservation in the Steel Rolling Process"

SOURCE: Beijing GANGTIE [IRON AND STEEL] in Chinese No 8, Aug 82 p 78

ABSTRACT: The Second Conference on Energy Conservation in the Steel Rolling Process of the China Society of Metals was held in Guangzhou on 18-23 May 82. Participants included 66 delegates of 46 organizations, including various steel rolling mills, colleges, and scientific research and designing departments. Related scientists of China Society of Metals, the Energy Resources Office of Ministry of Metallurgy, Societies of Metals of Guangdong Province, Hubei Province, Liaoning Province, and Shanghai, and Bureaus of Metallurgy of Shanghai and Guangzhou also attended. The conference received 36 papers and 14 were read. Following discussions on the situation, direction of development, and existing problems with respect to energy conservation, the delegates believed that comparing 1981 with 1980, the annual rate of reduction of heat energy consumption of 5 percent represented the effectiveness of energy conservation measures. Moreover, there have also been progresses in replacing oil with coal, using local materials, enlarging the source of fuel, etc. A continuation of propaganda for energy conservation, strengthening scientific management, and co-operative research on certain worthwhile energy conserving items were suggested. The delegates were organized to tour the Guangzhou Steel Rolling Mill and the Guangzhou Steel Rolling Mill No 3.

6248

CSO: 4009/396

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TITLE: "A Study of Kaschi-Beck Disease Associated With Environmental Selenium in Shaanxi Province"

SOURCE: Dalian HUANJING KEXUE XUEBAO [ACTA SCIENTIAE CIRCUMSTANTIAE] in Chinese Vol 2 No 2, Jun 82 pp 91-101.

TEXT OF ENGLISH ABSTRACT: In order to study Kaschi-Beck Disease in relation to environmental selenium, authors have collected samples of drinking water, soils, various kinds of grains, and children's hair from 130 locations in both affected and nonaffected areas according to different natural and geographical types in Shaanxi Province from 1978 to 1981, and also analyses of selenium were made in these samples. It can be seen from the results that the disease-affected areas all are of an environment where the selenium content stands very low, for example, in drinking water there are fewer than 0.2ppb in grains (average of wheat and corn,) fewer than 10ppb in over 95 percent of the samples examined, while in hair which reflects Se content in human body, there are fewer than 110ppb in over 92 percent of 478 children. In contrast, the areas where no Kaschi-Beck Disease has shown up are of an environment with low, medium, and high Se content in water, soils, and grains. The

[continuation of HUANJING KEXUE XUEBAO Vol 2 No 2, 1982 pp 91-101]

amount of Se provided for the children from water and grains has been calculated at 5.4 μ g or so, with the lowest daily uptake in the nonaffected areas. It can also be shown by analyzing the results of the samples in all the locations that the amount of selenium in grains consists of up to 90 percent of the total amount of Se in grains and water in most locations in the areas and it has also indicated that grains are the main Se source in these areas. But in areas where the Se content in grains is low and that in water is high, Se from water may make a bigger contribution to Se in human body and no Kaschi-Beck Disease has so far been found. Preventive measures have been taken by periodic oral admission of sodium selenite (Se 1 mg/week) or salts with small amounts of sodium selenite (5 mg/kg.) They have proved to be effective in raising the Se content in the hair of the children in the disease affected areas.

AUTHOR: HU Rongmei [5170 2837 2734]
RUAN Yinlong [7086 6892 7893]
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ORG: All of Nanjing Institute of Pedology, Chinese Academy of Sciences

TITLE: "Study of Fluorine Pollution in Soil in Baotou Region"

SOURCE: Dalian HUANJING KEXUE XUEBAO [ACTA SCIENTIAE CIRCUMSTANTAE] in Chinese
Vol 2 No 2, Jun 82 pp 143-149

TEXT OF ENGLISH ABSTRACT: Fluorine pollution in soil in Baotou Region has been studied and described. Distribution of soluble and total fluorine in soil can in some way reflect range and level of fluorine pollution in air in that region. Atmospheric fluorine pollution in this region can hardly be compared with that caused by tail-ore dam, involving solid waste and wastewater from ore-dressing and sintering plants, which according to data are main sources. Accumulation rate of fluorine in soils downstream of the dam is very high, sometimes over one ton fluorine per hectare per meter. Fluorine pollution in soil also causes contamination of ground water and vegetables. That results in relocation of the neighboring production units several years ago. It becomes clear that it is not the air fluorine pollution but the soil fluorine pollution intensified partly by the tail-ore dam. In view of serious impact made by the tail-ore dam on the environment, practical suggestions should be advanced to take preventive measures for extensive protection.

6248

CSO: 4009/342

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